ENGO 419 – Fall 2021
Geomatics Networks
Lab Assignment #2

Deadline: October 29, 2021 (11:59 PM)

Question #1: Least-Squares Adjustment and Data Snooping (100%)

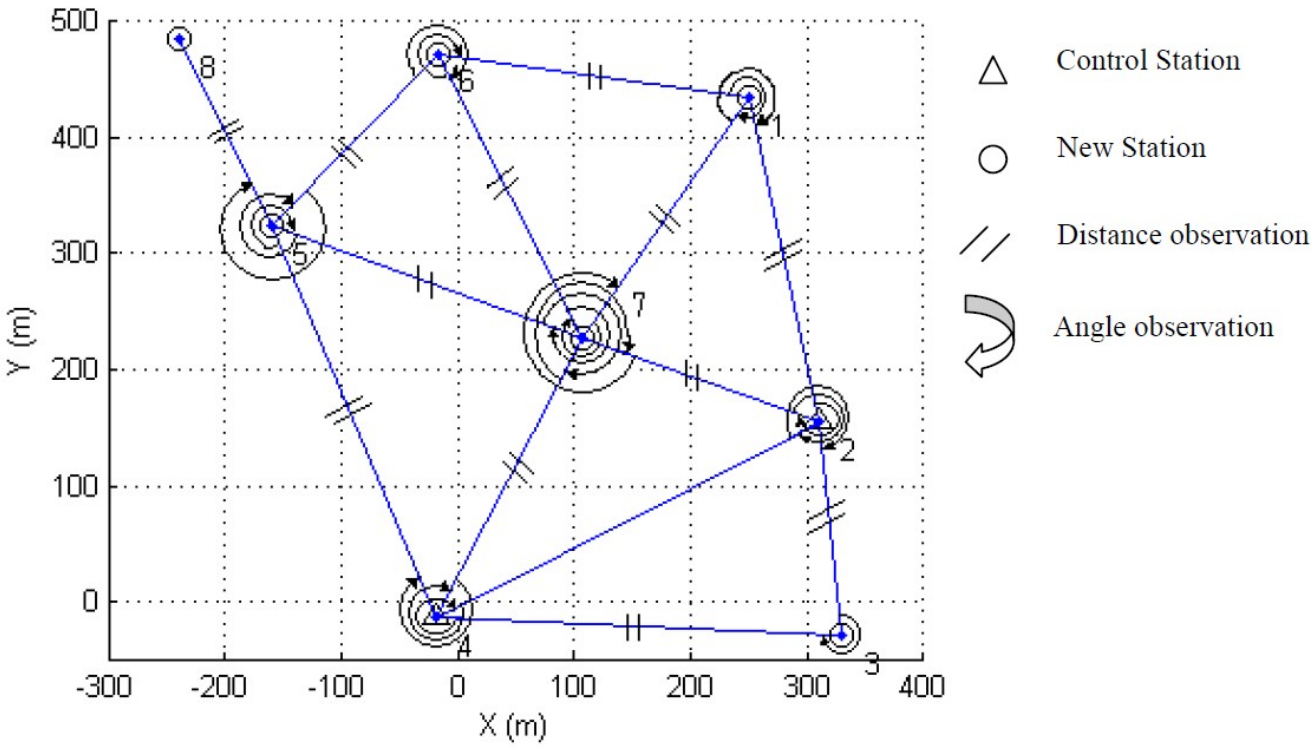


Figure 1

a) Compute the least-squares solution for the coordinates of the network in Figure 1 and their variance-covariance matrix, using the given observations (files ***angles.txt*** and ***distances.txt***). Use a 0.5 mm threshold for iterations and the given known coordinates of the control points 2 and 4 (file ***coords.txt)***.

b) What problem can you encounter if the initial values we use for the coordinates are not good?

d) Perform a global χ^2 test of the residuals (a-posteriori variance factor) for a 95% confidence level (χ^2 values are given in file ***Chi.txt*** and table 1 at the end of this handout).

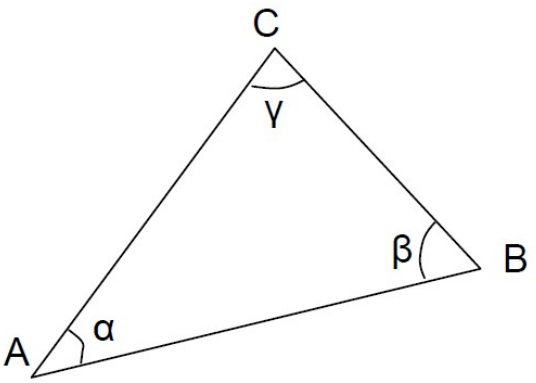
e) What are the possible cause of the failure of χ^2 test ?

f) Compute the least-squares solution of the coordinates using new weights (rescale with $\hat{\sigma}_0^2$).

g) What is the effect of reweighting?

h) Apply data snooping for the solution in (a) using a 95% confidence level and comment on the results.

***Hint**: Derive the approximate coordinates for the unknown points from the known coordinates of points 2 and 4 and the observed angles, by using the following formulas:*



$$Y_C = \frac{(X_B - X_A) + Y_B \cot\alpha + Y_A \cot\beta}{\cot\alpha + \cot\beta}$$

$$X_C = \frac{(Y_A - Y_B) + X_B \cot\alpha + X_A \cot\beta}{\cot\alpha + \cot\beta}$$

Start from one point and one triangle at a time!

Files provided (download from D2L):

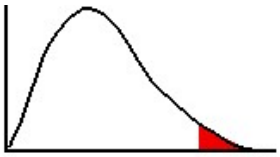
Matlab files	Observation files
Ang.m	angles.txt
Dist.m	distances.txt
	Chi.txt
	coords.txt

Lab Assignment #2 Deliverables:

Lab Assignment #2 should be submitted on D2L (Assessments/Dropbox/Lab Assignment #2) with a file name as "Last Name_First Name_UCID_Lab Assignment 2". The file should include:

- *Solutions for Question #1 with all intermediate steps.*
- *Source codes and program outputs. Note that your code must be working and providing results.*

Table 1: critical values for the χ^2 test



To find this region use the value equivalent to α at the top of the table.

To find this region use the value equivalent to $1-\alpha$ at the top of the table.

df\area	.995	.990	.975	.950	.900	.750	.500	.250	.100	.050	.025	.010	.005
1	0.00004	0.00016	0.00098	0.00393	0.01579	0.10153	0.45494	1.32330	2.70554	3.84146	5.02389	6.63490	7.87944
2	0.01003	0.02010	0.05064	0.10259	0.21072	0.57536	1.38629	2.77259	4.60517	5.99146	7.37776	9.21034	10.59663
3	0.07172	0.11483	0.21580	0.35185	0.58437	1.21253	2.36597	4.10834	6.25139	7.81473	9.34840	11.34487	12.83816
4	0.20699	0.29711	0.48442	0.71072	1.06362	1.92256	3.35669	5.38527	7.77944	9.48773	11.14329	13.27670	14.86026
5	0.41174	0.55430	0.83121	1.14548	1.61031	2.67460	4.35146	6.62568	9.23636	11.07050	12.83250	15.08627	16.74960
6	0.67573	0.87209	1.23734	1.63538	2.20413	3.45460	5.34812	7.84080	10.64464	12.59159	14.44938	16.81189	18.54758
7	0.98926	1.23904	1.68987	2.16735	2.83311	4.25485	6.34581	9.03715	12.01704	14.06714	16.01276	18.47531	20.27774
8	1.34441	1.64650	2.17973	2.73264	3.48954	5.07064	7.34412	10.21885	13.36157	15.50731	17.53455	20.09024	21.95495
9	1.73493	2.08790	2.70039	3.32511	4.16816	5.89883	8.34283	11.38875	14.68366	16.91898	19.02277	21.66599	23.58935
10	2.15586	2.55821	3.24697	3.94030	4.86518	6.73720	9.34182	12.54886	15.98718	18.30704	20.48318	23.20925	25.18818
11	2.60322	3.05348	3.81575	4.57481	5.57778	7.58414	10.34100	13.70069	17.27501	19.67514	21.92005	24.72497	26.75685
12	3.07382	3.57057	4.40379	5.22603	6.30380	8.43842	11.34032	14.84540	18.54935	21.02607	23.33666	26.21697	28.29952
13	3.56503	4.10692	5.00875	5.89186	7.04150	9.29907	12.33976	15.98391	19.81193	22.36203	24.73560	27.68825	29.81947
14	4.07467	4.66043	5.62873	6.57063	7.78953	10.16531	13.33927	17.11693	21.06414	23.68479	26.11895	29.14124	31.31935
15	4.60092	5.22935	6.26214	7.26094	8.54676	11.03654	14.33886	18.24509	22.30713	24.99579	27.48839	30.57791	32.80132
16	5.14221	5.81221	6.90766	7.96165	9.31224	11.91222	15.33850	19.36886	23.54183	26.29623	28.84535	31.99993	34.26719
17	5.69722	6.40776	7.56419	8.67176	10.08519	12.79193	16.33818	20.48868	24.76904	27.58711	30.19101	33.40866	35.71847
18	6.26480	7.01491	8.23075	9.39046	10.86494	13.67529	17.33790	21.60489	25.98942	28.86930	31.52638	34.80531	37.15645
19	6.84397	7.63273	8.90652	10.11701	11.65091	14.56200	18.33765	22.71781	27.20357	30.14353	32.85233	36.19087	38.58226
20	7.43384	8.26040	9.59078	10.85081	12.44261	15.45177	19.33743	23.82769	28.41198	31.41043	34.16961	37.56623	39.99685